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Ground-Surface Condition and Apparently Dry Environment in the Seasonally Wet Tropics —With Special Reference to the Case of Northeast Thailand—

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Introduction

Northeast Thailand, which is in this workshop mentioned as one of the typical dry areas in Southeast Asia, receives more than 1,100mm of annual rainfall although it concentrates in the season from April to October. The climatic condition demonstrates that the Northeast is not so much dryer than most of other areas of Thailand except the mountains and the peninsular. The Northeast is, however, perceived to be the driest area in Thailand. The perception seems to be evolved from the difficulty in obtaining water in the dry season. Deficiency in surface water balance is derived from the lacking of big rivers, and from high infiltration rate, apart from high evapotranspiration. Although this ground-surface condition is often attributed to sandy bedrock, it is more directly controlled by surface cover deposits and vegetation.

The Fine Surface Cover Deposits

Most of gently undulating ground-surface except floodplains and steep slopes in Northeast Thailand is underlain by the Fine Surface Cover deposits (FSC) of fine sandy to clay-loamy texture (Tamura, 1992). Their lithofacies and mode of occurrence show that the processes of their formation are unconcentrated surface

wash, local flood, soil creep, wind action, and some biotic activity. Their stratigraphic relation to other deposits and some radiocarbon dates obtained from them indicate that they have been formed during the last thousands to hundred thousands of years.

As a results of their extensive distribution, the FSC provides parent material for most soil series ranging from deep red to dull brown in their color, which are frequently referred to as infertile soils distributed on gently undulating uplands of Northeast Thailand. Their sand-dominant texture promotes infiltration of rain water and their friableness makes their redistribution easy particularly when they are exposed. Permeable ground-surface has been thus extended and maintained on the uplands, and, at the same time, development of surface-drainage networks has been hindered. Of course, redistribution of the FSC by wind was active in arid periods and that by some water-induced processes was more effective in humid periods in changing environment in the Quaternary.

Degradation of Land Cover

Not only earth-surface material such as the FSC but also vegetation cover inevitably affects infiltration. Apart from the problem that the deciduous Dipterocarp forest presents a true natural vegetation of gently undulating uplands in Northeast Thailand, extensive degradation of vegetation due to a large quantity of fuel-wood supply for iron smelting and salt making in hundreds to thousands of years ago (Nitta, 1992, 1995) and to rapid forest clearance for agricultural development in recent tens of years (Takaya, 1984) should be remarked and evaluated from the viewpoint of ground-surface hydrology and earth-surface material transfer. Disappearance of forest on sandy ground generally brings increase in infiltration at first because of decrease in both interception and transpiration and later induces the occurrence of surface wash which leads to erosion and redistribution of earth-surface material. It is also pointed out in the areas of salty groundwater that forest clearance brings watertable rising to connect capillary zone, which is resulted in the expansion of salt affected fields and

contributes the increase of apparent dryness of ground-surface.

In addition to the anthropogenic degradation of vegetation in recent thousands of years, vegetation change corresponding to global and local environmental changes in ten thousands to hundred thousands of years must influenced the formation of the FSC.

Influence of Sandstone-rich Bedrock

Although permeable, friable and infertile soil properties of gently undulating uplands of Northeast Thailand are due to the FSC, and the material of the FSC is mostly supplied from the underlying bedrock in which semiconsolidated sandstone predominates particularly in its upper part, resembling fine-textured surface deposits are distributed more extensively in various places of tropical continents where bedrock lithology is diverse (Tamura, 1995a). There is no doubt that the sandstone-rich bedrock plays other role in the formation of apparently dry environment of the Northeast. In this context it should be taken note that lithofacies of the bedrock, particularly the Mahasarakham Formation of Late Cretaceous to early Paleogene age, promotes deep percolation of water, which reduces surface water supply.

The lithology-controlled hydrologic processes must have been prevailed since the extinction of the Mahasarakham salt lake several tens of million years ago and are resulted in some geomorphic features such as sparse drainage density and limited development of floodplains in the Northeast. The long-term relationship among geology, hydrology and geomorphology may be proved by morphometric analysis which is in operation.

Similar Cases in Other Tropical World

In the seasonally wet tropics, there are several areas which show dry appearance than actual climate.

In Northwestern Zambia, the dry evergreen forest, which may correspond to

the areas' subhumid climate with about 1,100mm of annual rainfall and six months of dry season, is sporadically remained in substitutionally expanded deciduous woodland on the sandy plateau. The plateau is composed of the terrestrial Lower Kalahari Sands of Cretaceous or Tertiary age, which are overlain by the eolian Upper Kalahari Sands of early to late Pleistocene age (Tamura, 1989). The replacement of evergreen forest by deciduous Miombo woodland seems to have begin several thousand years ago by the spreading of shifting cultivation (Tamura, 1995b).

The Foot Plateau behind the East African coast is composed of subaqueous and essentially non-calcareous sandy to muddy sediments of probably Neogene or Plio-Pleistocene age, which are called the Marafa Beds in Kenyan coast, and are partly covered by eolian sandy deposits of late Pleistocene age. Both the Marafa Beds and the eolian sandy cover provide parent material for reddish Arenosol and Ferralsol (Tamura in Toya et al., 1973). Vegetation landscape of the Foot Plateau shows much dryer appearance than that expected from the subhumid tropical climate with biannual rainfall pattern particularly in its western (inland) part.

The plateau called Tabuleiros in Brazilian Northeast (Nordeste) is composed of unconsolidated sandy sediments, the Barreiras Group, of Pliocene to early Pleistocene age, on which red yellow "podzolic" soil is formed in a subhumid to humid tropical climate with about 50mm of rainfall in the driest month. Recent deforestation for extensive sugar-cane cultivation has reduced transpiration and formed hardpans in shallow soil profiles. Such a change in ground-surface condition is resulted in the formation of quartz-rich sandy hydromorphic soil which is very infertile (Matsumoto, 1994) and increases the dry appearance of the land.

It should be remarked that the areas mentioned above are commonly composed of sandy bedrock overlain frequently by loose sandy cover deposits. Moreover anthropogenic degradation of vegetation brings dryer appearance than the landscape expected from the area's climatic condition.

Concluding Remarks

Dry appearance of Northeast Thailand is magnified from the actual climatic condition by surface hydrologic features provided directly by sandy cover deposits which are the products of sandy bedrock geology and surface micro-geomorphic processes. Anthropogenic degradation of vegetation contributes the increase of apparent dryness of ground-surface. Similar phenomena are observed in some other areas in the seasonally wet tropics. These facts suggest that apparent dryness can be reduced by the effective control of hydrologic processes through soils, surface deposits and vegetation. Further investigation should be made in Central Vietnam, Upper Burma, East Java, and some other "dry" areas in Southeast Asia.

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